

REMARKS

Claims 1 and 23 are amended to recite the thickness of the inorganic oxide layer. This amendment is supported at least by page 4 (bottom) of the specification. Claims 1 and 23 are also amended to recite the maximum/minimum thickness ratio more clearly.

REJECTIONS UNDER 35 U.S.C. 112

Claims 24 and 25 stand rejected as being non-compliant with the written description requirement of 35 U.S.C. § 112, first paragraph. Applicants request reconsideration of this rejection.

The examples presented in the specification make it clear that the inorganic oxide layer can be substantially composed of inorganic oxide materials. In Example 1, the inorganic oxide layer is composed substantially of silicon oxide. In Example 2, the inorganic oxide layer is composed substantially of a silicon oxide/aluminum oxide composite. Likewise, the inorganic oxide layer in Example 4 is composed substantially of a silicon oxide/aluminum oxide composite.

The specification also makes it clear that the inorganic oxide layer may include a composite of two or more oxides. On page 6, second paragraph, the specification reads: “When the inorganic oxide layer of the functional roll film comprises a composite oxide matter in which at least two kinds of oxide matters are mixed ...”

Based on these details in the specification, a person of ordinary skill in the art would understand that the present invention encompasses inorganic oxide layers consisting “substantially of one or more inorganic oxides.” For at least these reasons, Applicants respectfully submit that claims 24 and 25 are compliant with the written description requirement. Accordingly, withdrawal of the rejection is respectfully requested.

REJECTIONS UNDER 35 U.S.C. 103

Claims 1-3 and 21-25 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Hirokawa et al. (US 5,230,923) in view of Misiano et al. (US 5,462,779). Applicants respectfully request reconsideration.

Independent claims 1 and 23 recite a plastic film having an inorganic oxide layer. The inorganic oxide layer is 10-50 nm thick. Furthermore, the inorganic oxide layer has an extremely

uniform thickness extending across a large area (i.e., across a given portion of the plastic film measuring at least 400 mm width \times 4,000 meter length). This feature is recited as follows: “wherein the inorganic oxide layer on a portion of the plastic film measuring at least 400 mm width by at least 4,000 meter length has a maximum thickness that is equal to or less than 1.5 times the minimum thickness as measured over both the width and length directions.”

Example 1 in the specification demonstrates these remarkable features of the plastic film. In Example 1, the plastic film was cut into a 4,000 meter \times 500 mm portion and measured at 10 different points on this portion. As shown in Table 1 on page 26 of the specification, the inorganic oxide layer on this 4,000 meter \times 500 mm portion of the plastic film had a minimum measured thickness of 17.1 nm and a maximum measured thickness of 22.8, representing a difference of only 5.7 nm and a maximum/minimum thickness ratio of only 1.33. This 5.7 nm (0.000,000,005,7 meters) difference in thickness is across the entire 4,000 meter length and 500 millimeter width of the film portion. To understand these dimensions in a different way, this variation in thickness is about 7×10^{11} times smaller than the length and about 88,000,000 times smaller than the width of the film portion!

The present invention is able to achieve such high uniformity by using the vacuum evaporation apparatus shown in FIG. 1, as described in pages 18-23 of the specification. In particular, the apparatus of FIG. 1 uses a specially constructed fluorescent x-ray monitor 7 (see pgs. 20-21) to measure the thickness of the inorganic oxide layer during the manufacturing process. These measurements are used for feedback control of the thin layer deposition process. Furthermore, this x-ray monitor 7 can work in conjunction with a specially constructed measuring roll 5 designed to reduce variations in the irradiation distance so as to enhance measurement accuracy by the x-ray monitor 7 (see pg. 20, first full paragraph).

In contrast to the plastic film of Example 1, the plastic film of Comparative Example 1 described in the specification at pages 25 and 26 was made with a vacuum evaporation apparatus that used an *optical monitor*, instead of a fluorescent x-ray monitor, to measure the thickness of the inorganic oxide layer for feedback control. Unlike the plastic film of Example 1, this plastic film of Comparative Example 1 had wider variations in the thickness of the inorganic oxide layer (max/min ratio of 2.8) and substantially inferior gas barrier properties.

Likewise, Example 2 described in the specification (pg. 27) was made using the apparatus of FIG. 1. The plastic film of Example 2 was cut into a 4,000 meter \times 500 mm portion,

and the thickness of the inorganic oxide layer was measured over this 4,000 meter \times 500 mm dimension (see Table 2 on pg. 28). The minimum thickness of the inorganic oxide layer was 12.8 nm and the maximum thickness was 17.2 nm, giving a maximum/minimum ratio of only 1.34. In contrast, the plastic film of Comparative Example 2 was made with an apparatus using an *optical monitor*, instead of a fluorescent x-ray monitor. Unlike the plastic film of Example 2, the plastic film of Comparative Example 2 had wider variations in the thickness of the inorganic oxide layer (max/min ratio of 2.1) and substantially inferior gas barrier properties.

Hirokawa makes plastic films with an apparatus that uses an optical monitoring system.

Like the deposition apparatus used for making the films of Comparative Examples 1 and 2, Hirokawa also makes plastic films with an apparatus that uses a conventional *optical monitoring system* (see col. 8, lns. 2-4) for feedback control. But as Applicants have experimentally proven in Comparative Examples 1 and 2, an optical monitoring system, such as the one used by Hirokawa, cannot achieve the layer thickness uniformity recited by the claims.

As requested by the Office and at Applicants' own expense, Applicants made the plastic film of previously cited Masuda and demonstrated that it does not meet the claimed invention. But Applicants do not have the time or resources to make every plastic film known in the prior art, nor is it the policy of the Office to overburden patent applicants with such requirements. Applicants have satisfactorily explained why Hirokawa cannot meet the claimed invention based on Applicants' experimental proof that a deposition apparatus using optical monitoring system cannot make plastic films of the claimed invention.

Misiano does not employ *any type* of monitoring system for feedback control, and thus, does not cure the above-mentioned deficiencies of Hirokawa.

Hirokawa teaches away from a 10-50 nm thickness range for the inorganic oxide layer.

Claims 1 and 23 recite that the inorganic oxide layer has a 10-50 nm thickness. Within this range, the inorganic oxide layer is thick enough to serve as a gas barrier, but at the same time, thin enough to provide the flexibility needed to resist cracking and/or delamination of the inorganic oxide layer.

Hirokawa does not specifically disclose a 10-50 nm thickness for the inorganic oxide layer and exhibits no knowledge of the advantages of this thickness range. Rather, Hirokawa

identifies 3,000 Å (300 nm) as the cut-off point where cracking becomes a problem (see col. 4, lns. 47-50). Thus, Hirokawa provides no motivation to use a 10-50 nm thickness for the inorganic oxide layer.

Likewise, Misiano does not disclose an inorganic oxide layer having a 10-50 nm thickness and provides no motivation to modify Hirokawa in such a manner.

Hirokawa does not disclose uniform thickness over the recited dimensions.

In the claimed invention, the uniformity in the thickness of the inorganic oxide layer is across both the length and width directions over at least 400 mm in width and at least 4,000 meter in length.

In contrast, Hirokawa measured thickness only over the length direction, and for a shorter distance than the at least 4,000 meter length recited in the claims. In Hirokawa, the thickness of the inorganic oxide layer was measured over the length of the film for a period of about 80 minutes (see FIG. 17) while the film was traveling at a speed of 30 meters/minute (see col. 7, ln. 68 – col. 8, ln. 3). This translates to a length distance of only about 2,400 meters – substantially less than the at least 4,000 meter length distance recited by the claimed invention.

Furthermore, Hirokawa did not measure the thickness across the width of the plastic film, nor is it possible for the apparatus of Hirokawa to achieve the recited level of uniformity in the width direction (also referred to as TD, transverse direction). The present invention is able to achieve such high uniformity in the width direction because the vacuum evaporation apparatus uses a partitioned crucible (see pg. 21, last paragraph – pg. 23, last paragraph; FIGS. 2 and 3). As experimentally shown in FIG. 4 (explained at page 23, last paragraph), when alternating blocks of aluminum oxide and silicon oxide are partitioned in the crucible, the total thickness (line “c”) is uniform across at least a 400 mm width.

In contrast, Applicants have experimentally proven that conventional crucibles (without the partitioning) cannot achieve this thickness uniformity in the width direction. FIG. 5 shows the total thickness (see line “c”) of the inorganic oxide layer that was deposited using a conventional crucible.

Claim 2

With respect to claim 2, the Office Action asks what is the purpose of the recited wt% composition of the one component. This composition allows for a mixed composition inorganic layer to have good gas barrier properties, while still allowing the layer to remain transparent.

Applicants provide the attached Exhibit 1 for illustration. In the case where the inorganic oxide layer is made only of silicon oxide (see Panel A), there are large voids in the molecular matrix that allow gas permeation. Thus, the silicon oxide film would have to be made thicker to reduce gas permeability. But increasing the thickness would reduce the flexibility of the silicon oxide layer.

Panel B illustrates the scenario where the inorganic oxide layer has a mixed composition of both silicon oxide and aluminum oxide. Here, the aluminum oxide is believed to fill the interstices in the silicon oxide matrix, thereby reducing gas permeability. This effect is not recognized by either Hirokawa or Misiano.

For at least these reasons, Applicants respectfully submit that claims 1-3 and 21-25 are non-obvious over Hirokawa and Misiano. Accordingly, withdrawal of the rejection is respectfully requested.

CONCLUSION

Applicants respectfully submit that the present application is in condition for allowance. The Examiner is invited to contact Applicants' representative to discuss any issue that would expedite allowance of this application.

In case the filing of this paper is deemed untimely, Applicants request an extension of time. The Commissioner is authorized to charge all required fees, fees under § 1.17, or all required extension of time fees, or to credit any overpayment to Deposit Account No. 11-0600 (Kenyon & Kenyon LLP).

Respectfully submitted,

/Steven S. Yu/

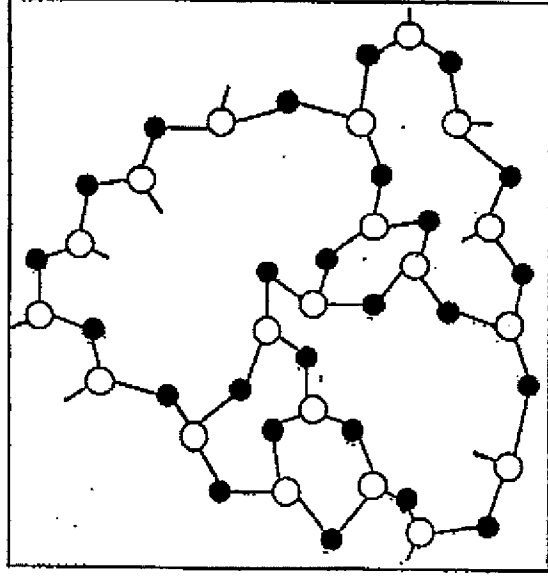
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Structure of Thin Film

(A)



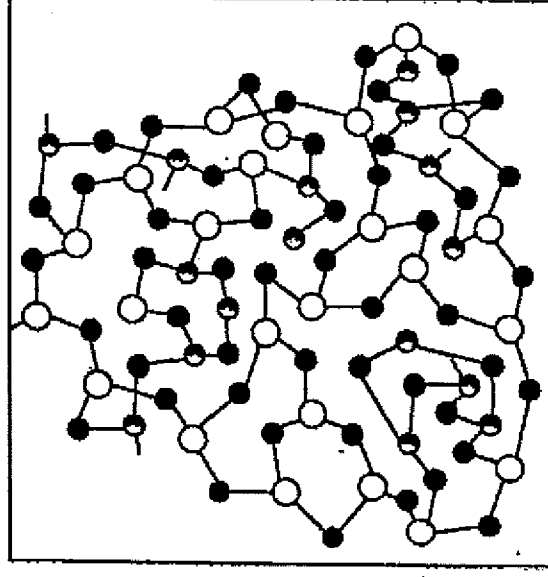
SiO₂

ADDITION OF
Al₂O₃



● O atom
○ Si atom
◐ Al atom

(B)



SiO₂+Al₂O₃